Conceptual Site Model for the Yerington Mine Site

October 10, 2002

PREPARED FOR:

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BROWN AND CALDWELL
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RESPONSE TO COMMENT LETTER
ON
FINAL DRAFT CONCEPTUAL SITE MODEL

OCTOBER 9, 2002

Atlantic Richfield Company

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October 9, 2002

Mr. Arthur G. Gravenstein, P.E.
Staff Engineer
Bureau of Corrective Actions -- Remediation Branch
Nevada Division of Environmental Protection
333 W. Nye Lane
Carson City, Nevada 89701

Subject: Submittal of the final Conceptual Site Model for the Yerington Mine Site and Response to Comments on the Draft Final Conceptual Site Model dated August 26, 2002

Atlantic Richfield has prepared the final Conceptual Site Model (CSM) for the Yerington Mine Site dated October 9, 2002. The attached CSM reflects the final set of comments provided by the regulatory agencies on September 26, 2002 for the subject document. These comments and Atlantic Richfield's responses are provided below.

<u>General Comments</u>

Figure 1:

a) Terrestrial biota should be added for fugitive dust. Some of the specific ecological receptors include livestock (horses) and crops. The exposure route should include dermal and incidental ingestion.

Atlantic Richfield has previously stated that we do not believe a defensible analysis of the effects of fugitive dust on terrestrial biota (i.e., ecological receptors) by dermal and incidental ingestion can be achieved, or that potential effects can be quantified. We also do not believe an analysis of this type is warranted for the Yerington Mine Site given that the concentrations of metals in most of the existing data available for surface mine units is similar to background soil concentrations, generally less than EPA Region 9 PRGs, and may not be distinguishable from other fugitive dust sources in the area (e.g., other mine sites and agricultural activities). However, in the interest of moving forward with regulatory acceptance of the Conceptual Site Model, we have modified Figure 1 to include these concepts.

b) The dermal exposure route should be added for sediment for human and ecological receptors.

The dermal exposure route will be added for sediment for human and ecological receptors. However, it must be noted that any exposure within the Wabuska Drain must be considered within the context of the drain's designated agricultural use.

c) Food chain pathways should be listed on the figure or in the text (Atlantic Richfield's response to comments states that it is too difficult to depict this on the figure). It is important though since fish and/or hunting of game (deer/rabbits) are common in Yerington.

Food chain pathways will be described in the revised CSM text.

If you have any questions regarding the revised document or the responses to comments, please contact me at 1-406-563-5211 ext. 430.

Sincerely,

Dave McCarthy
Project Manager

cc: Bonnie Arthur, SFD-8-1,USEPA Region 9
Robin Bullock, Atlantic Richfield Company
Tad Williams, Walker River Paiute Tribe
Elwood Emm, Yerington Paiute Tribe
John Krause, Bureau of Indian Affairs
Stan Wiemeyer, U.S. Department of the Interior, Fish and Wildlife Services
Vicki Roberts/Johanna Emm, Yerington Paiute Tribe
Paul Thomsen, Office of Senator Harry Reid
Phyllis Hunewill, Lyon County Board of County Commissioners
Joe Sawyer, SRK Consulting
Dietrick McGinnis, McGinnis and Associates, LLC
Kris Doebbler, Bureau of Land Management

CONCEPTUAL SITE MODEL FOR THE YERINGTON MINE SITE

OCTOBER 10, 2002

CONCEPTUAL SITE MODEL
for the YERINGTON MINE SITE

October 10, 2002

Atlantic Richfield Company has developed this Draft Final Conceptual Site Model (CSM) for the Yerington Mine Site to assist the Yerington Technical Work Group (YTWG) in discussions regarding site investigations to be performed per the Closure Scope of Work and associated Work Plans. Three figures are attached to this text description: a flow diagram that illustrates potential sources, transport mechanisms, exposure pathways and receptors; a schematic block diagram that depicts these site model components, and a map of surface mine units and other relevant features overlain on a 2001 aerial photograph of the site.

The purpose of the CSM is to illustrate and describe a basic understanding of potential sources and media pathways, and possible receptors, based upon available site information. The CSM is not intended to provide details or quantification of these potential sources and pathways. More detailed information about potential sources and pathways will be presented in specific Work Plans for site closure. The CSM is considered a dynamic tool that will allow for hypothesis testing of the concepts described below, and graphically represented in the attached figures. Results of site investigations outlined in the Closure Scope of Work will improve the CSM. Atlantic Richfield anticipates that an updated CSM can be presented to the YTWG in 2003.

Potential Sources

Figure 1 is a flow diagram that illustrates three potential source categories (past and/or present) of constituents of concern (COCs) that may present a risk to human health and the environment. With the exception of possible past discharges of process solutions to the environment, these sources are also depicted in Figure 2, a schematic block diagram of surface mine units and important site and area features. All identified surface mine units, and related process areas, that may be current sources of COCs are shown in Figure 3. Identified source categories include:

- Surface mine units, and process areas (historic and current);
- Discharges of process solutions (historic discharges directly onto the natural ground surface or into unlined ponds, including infiltration to groundwater through the vadose zone); and
- The Yerington Pit Lake.

Surface Mine Units and Process Areas

Surface mine units, process areas and related mine site components are schematically presented in Figure 2, and major mine units are shown in Figure 3. Major surface units include tailings areas, process ponds, waste rock areas and leached ore heaps (heaps are constructed on relatively impermeable liners). Process, storage and maintenance areas associated with past mine operations are also potential sources. Additional mine units include solution pipelines (transite, metal or HDPE) and trenches, landfills and sewage lagoons.

Existing mine units are schematically shown in Figure 2. All surface mine units and disturbed areas are potential sources of fugitive dust. However, for the sake of the graphic representation in Figure 2, only the schematic waste rock pile, tailings pile and leach pad are shown to be sources on the figure. Also, fugitive dust may accumulate on or off the site, and may be re-suspended from either location by wind erosion (also indicated in Figure 1). Current active evaporation of heap drain-down may also be a source of COCs).

The schematic process and fuel storage area with buildings and ponds shown in Figure 2 is intended to represent both the Arimetco Electrowinning Plant site and the Mill and Precipitation Plant site on either side of the Weed Heights access road. Soils in these areas may be potentially contaminated by acidic solutions or petroleum hydrocarbons. Generic ponds and pipelines that may have been used for a variety of purposes, and composed of a variety of materials, are also schematically represented on the block diagram.

Discharges Of Process Solutions

Past discharges during mining operations of mine tailings (in slurry form) to lined and unlined impoundments, and discharges of acidic process solutions onto the natural ground surface and into lined and unlined evaporation ponds and designed solution collection ditches may have sourced COCs to underlying soils, the vadose zone and to groundwater via infiltration. Mine-related groundwater may also have entered the Wabuska Drain (a pre-existing agricultural return-flow ditch).

Yerington Pit Lake

The Yerington Pit Lake is a surface water body that has resulted from the accumulation of groundwater inflows to the pit from alluvial and bedrock flow systems, and from surface water derived from the Walker River (diverted during the 1997 flood). Groundwater inflows refilling the pit since the cessation of mine dewatering operations have a geochemical signature resulting from ambient chemical conditions and the interaction of groundwater with exposed bedrock in the pit walls. Mixing of groundwater types, evapoconcentration of dissolved constituents, and limnological processes in the pit lake result in evolving and complex pit lake water quality. The Yerington Pit is currently filling with groundwater, seepage from the Walker River through the alluvium, and alluvial groundwater flows. Future water balance conditions may allow pit water to flow into the bedrock groundwater flow system or allow the pit lake to serve as an evaporative sink.

Constituents of Concern

Based on the results of site investigations conducted to date, the following COCs have been identified at the Yerington Mine: arsenic, beryllium, cadmium, chromium, copper, iron, lead, selenium and zinc.

Potential Pathways

Potential pathways have been identified based on media, and include fugitive dust, soil, sediment, surface water and groundwater. These pathways may be linked to one another by various transport mechanisms, as shown in Figure 1 (light gray text and arrows). For example: fugitive dust (air pathway) may be linked to soils through dust accumulations and re-suspension of dust; sediment may be linked to surface water via leaching/runoff or sedimentation/chemical precipitation. Potential food chain pathways (not shown in Figure 1) may also allow receptors to indirectly ingest COCs. These pathways provide the links between sources and receptors. Release mechanisms of constituents of concern (COCs) from potential sources may include wind and runoff erosion, percolation of dissolved constituents from historic process water ponds, and leaching by meteoric water of surface mine units and process areas. These mechanisms are also shown schematically in Figure 2.

Erosion

Fugitive dust and contained COCs may be released and transported to potential receptors by wind erosion and atmospheric dispersion, which may accumulate in downwind areas. Erosion of surface mine units due to surface water runoff (e.g., stormwater or snowmelt events) may also occur at the Yerington Mine Site. Wind and runoff erosion may also release COCs to soils, sediments and surface water (e.g., the Wabuska Drain). Areas of soil, sediment or dust accumulation may become secondary sources of COCs to groundwater via leaching and percolation (Figure 1).

Percolation

Percolation of historic process solutions into the soil column, vadose zone and groundwater is a potential release mechanism that likely ceased when mine operations ended, when such solutions evaporated, and/or when surface mine units dried sufficiently to increase moisture storage capacity. Geochemical processes such as mobilization and attenuation may modify the concentration of COCs in percolating process solutions or leachate through soils or the underlying vadose zone (Figures 1 and 2).

Leaching

Leaching of COCs from surface mine units into underlying soils, the vadose zone and groundwater aquifers are also identified as potential release mechanisms. Infiltration of meteoric water containing leached COCs may provide a link between identified potential sources and the groundwater pathway (Figures 1 and 2). For example, the cross-sections of various mine units shown in Figure 2 depict the potential for meteoric water (as precipitation) to leach (mobilize) constituents from mine unit materials. Conversely, some COCs in meteoric water infiltrating through mine units may be attenuated (e.g., via adsorption).

Transport Mechanisms

A number of transport mechanisms link COCs released from potential sources to potential receptors. For example, fine-grained materials eroded from surface units and process areas may be transported by wind erosion and atmospheric dispersion (as fugitive dust) to downwind areas where they may accumulate and be re-mobilized. Other examples of potential transport mechanisms include COCs that may have entered, and been conveyed by, the Wabuska Drain to down-gradient receptors, and the potential release of COCs from sediments in the Drain to down-gradient receptors

Additional transport-related mechanisms or processes that may occur at the Yerington Mine Site are schematically represented in Figures 1 and 2. These include geochemical mobilization and attenuation during the infiltration of process waters or meteoric waters through the soil column and the vadose zone. Sedimentation and/or chemical precipitation may link sediment and surface water pathways. Similarly, seepage of groundwater to the Wabuska Drain or recharge from surface mine units and/or the Wabuska Drain to groundwater may also occur. Important groundwater processes (not schematically presented in Figures 1 and 2) that may affect the transport of COCs include colloidal transport, the presence of aquitards (i.e., clay layers), dispersion and dilution, and evaporation/transpiration.

The Yerington Pit Lake is hypothesized to currently be functioning as an evaporative sink. However, it is conceivable that groundwater may flow out of, and transport COCs from, the pit lake into the bedrock flow system when the pit lake reaches an “equilibrated” state. This potential transport mechanism is also shown in Figure 1.

Potential Receptors and Exposure Routes

Potential receptors include humans (workers, visitors and residents) and ecological (terrestrial and aquatic biota). Terrestrial biota may include wildlife or domesticated animals. Aquatic biota may include waterfowl, as schematically shown on Figure 2. Potential exposure routes to ecological receptors include the ingestion of, and dermal contact with, soils and surface water (Figure 2). Potential exposure routes to human receptors include:

- Ingestion of, or dermal contact with, COCs in soils and sediments;
- Inhalation of COCs in fugitive dust;
- Ingestion of COCs in groundwater;

- Ingestion of, or dermal contact with, COCs in surface water; and
- Ingestion of crops that uptake COCs from soils.
- Ingestion of livestock or wildlife (terrestrial or aquatic biota) that may have previously ingested COCs.

Uptake of COCs from soil and water by plants, or direct ingestion of water, may lead to possible bioaccumulation through the food web for various biotic and human receptors. Ecological receptors may also be exposed via dermal contact and the inhalation of dust. Fugitive dust generated during operations, and since mining operations ended, may contain COCs that could be inhaled by downwind workers, visitors or residents. The primary high-speed wind direction capable of suspending dust in the area of the Yerington Mine Site is to the northeast.

Soils developed on, or eroded from, surface mine units or associated with process areas may be mechanically transported into surface water features or COCs may be leached into the underlying soil column, vadose zone and groundwater. Historically discharged and ponded process solutions may have sourced COCs to groundwater aquifers by percolation. However, percolation ceased when mining operations ended and remaining water in the ponds evaporated. Remaining solids (i.e., precipitates) in the ponds may source COCs into the underlying soil column, vadose zone and groundwater via leaching by meteoric water (if sufficient head is available).

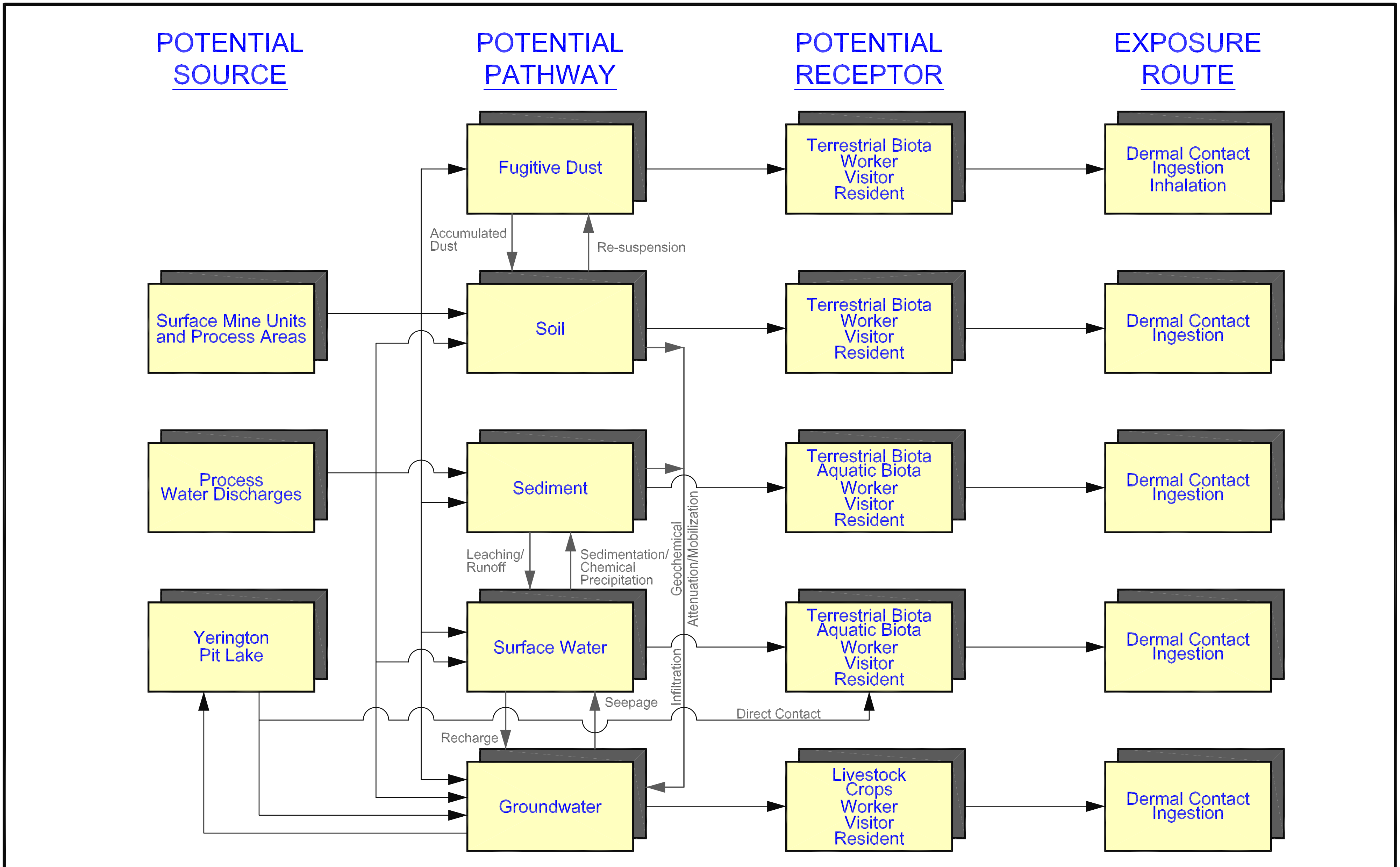
Existing surface units and inactive process areas may source COCs into the underlying soil column and vadose zone via unsaturated flow as a result of meteoric water flux through the units or areas. If moisture storage conditions in the surface units, underlying soils and vadose zone are exceeded as a result of direct precipitation or run-off, COCs may be leached into groundwater. Geochemical mobilization and attenuation processes will affect the ultimate loading of COCs to groundwater.

Additional Information

Important off-site features shown in Figure 2 include the Walker River and the Wabuska Drain. The river flow direction changes from north to northeast as it flows past the mine site, and the Drain was designed to flow to the north. The Drain returns to the River some 13 miles north of the mine site. Not shown on the block diagram, but seen in the cross section of the Yerington Pit, is the occurrence of flows from the Walker River through the alluvium into the pit. Groundwater conditions are generically depicted in Figure 2, but are too complex to show in any detail on this figure.

Groundwater flow direction and gradients in the shallow alluvial aquifer can be influenced by recharge and discharge components. The major source of groundwater recharge in the northern portion of the mine site is the result of agricultural application of surface water diverted from the Walker River and groundwater pumped from depth by supply wells. Additional sources of groundwater recharge in the southern portion of the mine site include recharge from the Walker River and from precipitation in the adjacent mountain block (Singatse Range). Discharge components that affect groundwater transport of COCs include the pumpback well system and evapotranspiration. Groundwater flow in the alluvium is generally to the north and northwest. Flow directions in the bedrock are not well known, but are likely affected by the Yerington Pit.

FIGURES



DATE:	PROJECT NUMBER:
August 2002	21243

BROWN AND CALDWELL
Carson City, Nevada

Explanation

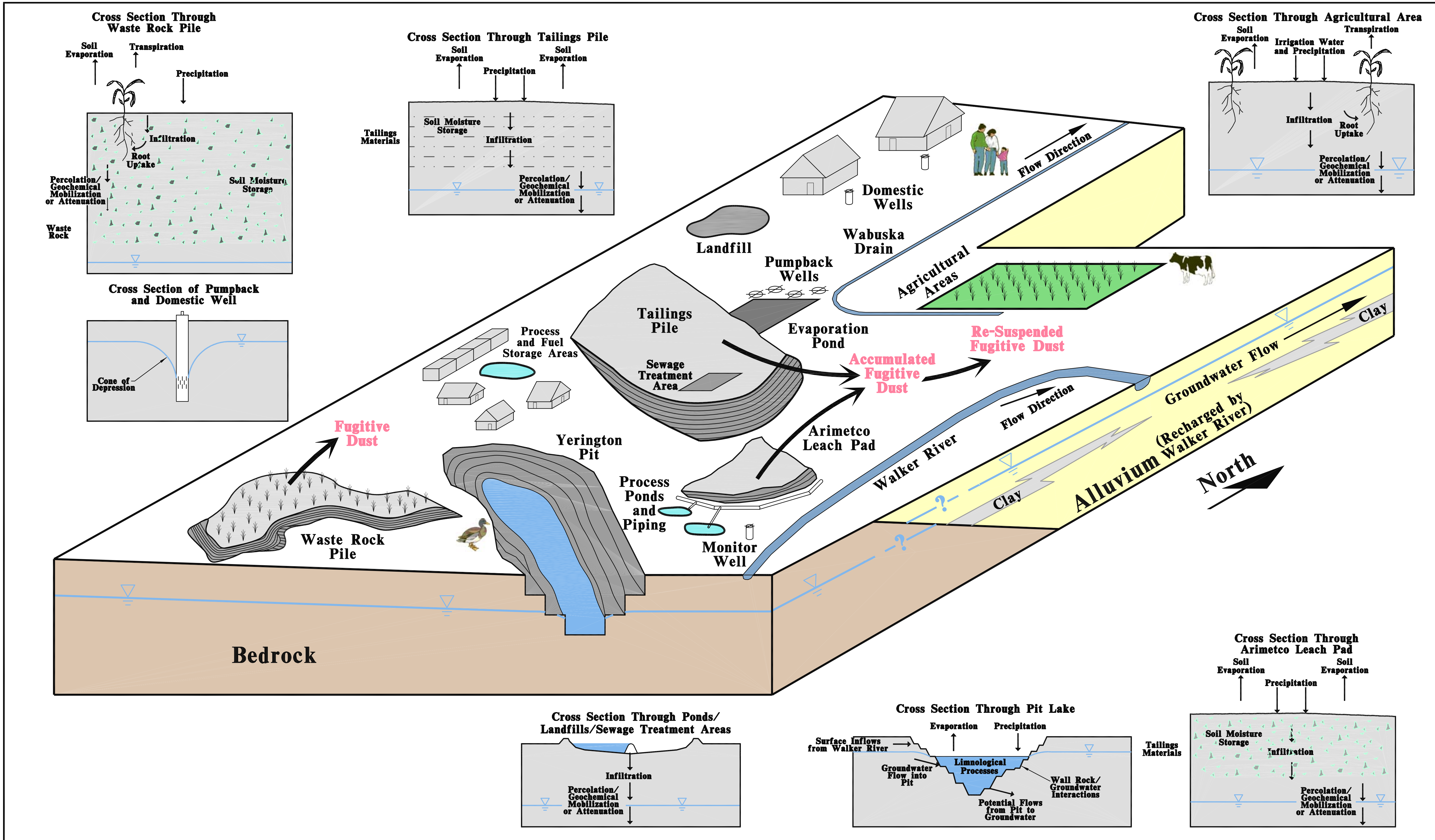
Potential Source-Media-Receptor Pathways

Inter-Media Transport Mechanism

Figure 1

Yerington Mine Conceptual Site Model Flow Diagram

Carson City Cad: P:\ARCO\21243\Site Model\CAD\F21243001.dwg (1=1) 10/10/2002 10:39:16 RJJ



BROWN AND CALDWELL
Carson City, Nevada

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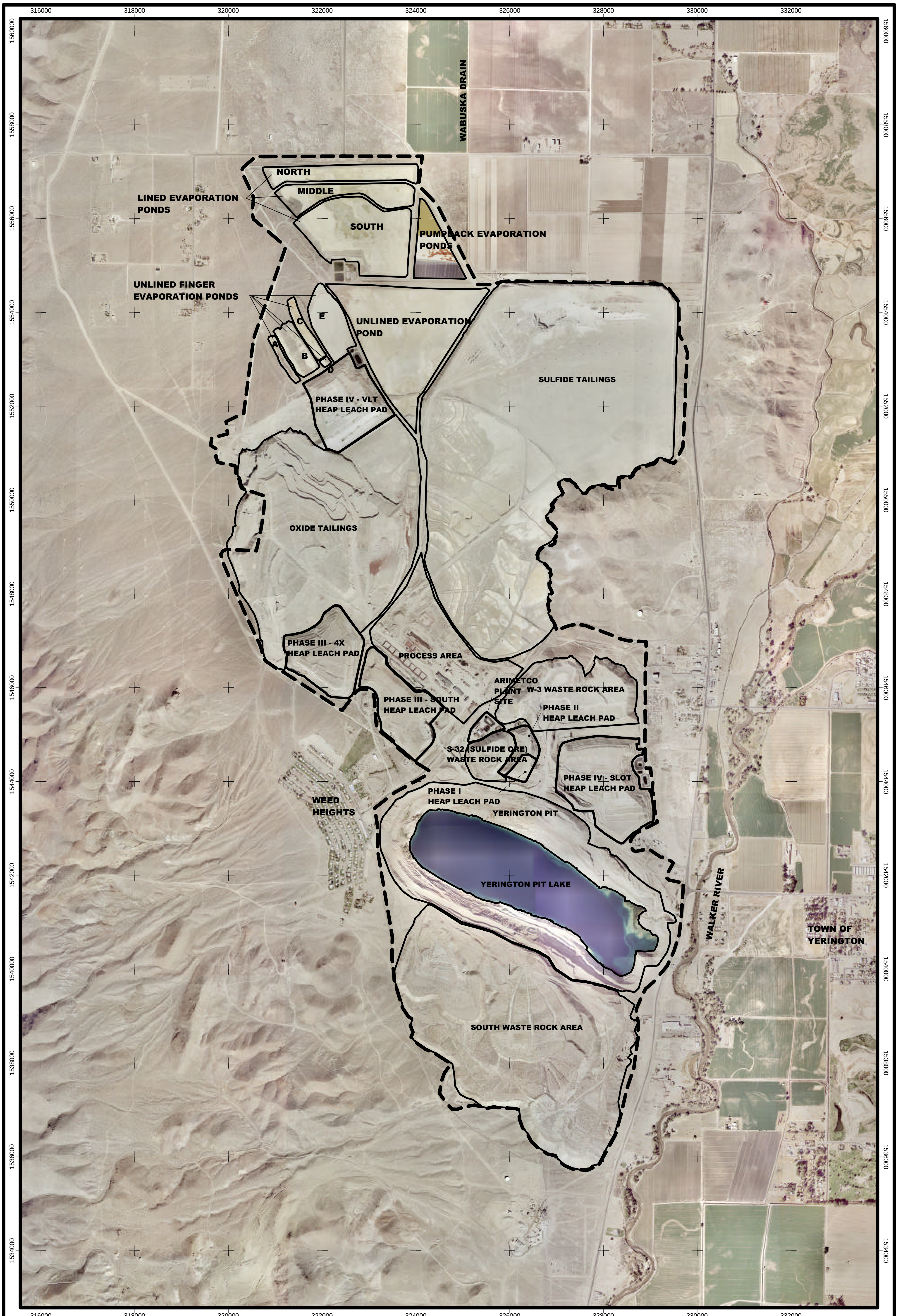
Figure 2

Yerington Mine Site Conceptual Model: Schematic Block Diagram



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE
1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 2001

EXPLANATION

MINE BOUNDARY

MINE UNIT

BROWN AND CALDWELL
Carson City, Nevada

DATE: AUGUST 2002

Atlantic Richfield Company

PROJECT NUMBER: 21243

SCALE:
700 0 700 1400 Feet
1:24000

N

FIGURE 3
SURFACE MINE UNITS

YERINGTON, NEVADA